pulmonary edema has subsided, the patient has to be kept under observation for a few weeks, because of the possible late onset of pneumonia or the development of inflammation of the smaller bronchial tubes known as bronchiolitis obliterans.

PSYCHOLOGIC REACTIONS

Having treated the patient's illness, what about the patient himself? As I pointed out at the beginning, the patient seems to look upon galvanized fumes as a pernicious and sinister agent. He has, somehow or somewhere, been imbued with a deep suspicion and an exaggerated fear of the consequences of welding fumes. He will not do well or recover fully unless we can exorcise this exaggerated fear. If we fail to allay his fears, he is apt to develop what, for want of a better name, we can call a "fumes neurosis," and he will continue to feel exhausted, without pep or ambition. He will then become more and more indisposed to return to work. Although we call this condition a neurosis, strictly speaking it is most often a sort of hysteria. It is really an hysterical reaction to an accident by a person with an underlying neurotic personality makeup. In other words, the patient makes unconscious use of the accident or illness to solve his personality difficulties. I repeat that the patient is not aware of this trick, or alibi, played by his subconscious mind. It seems as if the accident brings to a head those inner and outer complexes which he has been unable to solve normally or face squarely. The accident is, indeed, a cause of this hysterical reaction, but only a precipitating cause, for the ground is prepared by his personality makeup.

It is also true that the expectation of compensation plays a rôle, but it is not the chief rôle; and it is important that the physician realize this, for such patients are sensitive and touchy. The approach to them must be psychological. It is not wise to declare bluntly that there is nothing wrong with them, for such a statement is neither convincing nor complimentary. It is better to take an x-ray film of the chest, because in most cases the patient has a lurking fear that the fumes have damaged his lungs. This film should be shown to the patient, and the heart and lungs pointed out, in order that he may be convinced that the fumes have not damaged those "vital organs." If he is still unconvinced, he should be shown a normal film side by side with his own. That should convince him, because "x-rays don't lie." A nerve sedative will do the rest.

IN CONCLUSION

We may conclude this paper by repeating that welding is not really a hazardous occupation, provided the concentration of fumes is kept at a low level. It may also be stated that although, after many years of welding, the lungs may show certain fibrotic or nodular changes which, in an x-ray film, may remind one of early silicosis, there is neither the shortness of breath nor the tendency to tuberculosis which is seen in silicosis. It is important that the physician realize the essential harmlessness of these so-called "spots on the lungs," so that he may be able to explain away the fears of his patient and reassure him honestly and effectively.

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HEALTH CONTROL IN WELDING*

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IN the contract shipyards of the Maritime Commission and Navy we have today over a million employees. The yards themselves vary in size from a few thousand to 40,000. In many cases they are built on made land, and the workers are drawn literally from all walks of life. A maritime yard is lucky if it has more than a few per cent of workers who were shipbuilders before the war—the vast majority are green workers who have learned all they know about shipbuilding right in our yards since 1941. Jobs, such as welding, are about the same in all Maritime Commission yards, for there is little difference, from the health standpoint, in the way a freighter is built in Portland, Maine, in Houston, Texas, or in Portland, Oregon.

PRE-OCCUPATION EXAMINATIONS

On the East Coast, the Gulf, and on the Great Lakes, it is usual for new workers to be given preplacement physical examinations. In general, check-up examinations of men working on cranes, trucks, and the like are given at regular intervals; also jobs with possible occupational disease risk are checked from time to time. On the West Coast, however, the labor contract,[1] page 14, governing most of the region stipulates that:

"There shall be no doctor's physical examination nor age limit, except as required by law."

The Maritime Commission fully recognizes the validity of obligations existing under collective

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* Guest speaker, presented at the seventy-second annual session of the California Medical Association at Los Angeles, May 3, 1943.

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bargaining agreements, and with respect to physical examinations which would exist as a condition preceding employment, feels that the provisions in the Minimum Requirements for Safety and Health [2] do not present any direct conflict with the prevailing obligations of contractors on the Pacific Coast. The distinction must be made that the purpose of the physical examination provided for under the Minimum Requirements is based upon public policy directed toward insuring safe and competent workmen in particular jobs, and such examination is not a prerequisite for employment, occurring after employment but before placement on the job. This distinction should be borne in mind in considering the text of the recent Safety and Health Standards:

H-6. Examinations.

6.1. Physical examinations to insure proper placement of employees shall be given.

6.2. Periodic check examinations shall be given men working in occupations potentially hazardous to themselves or others, as for example, to crane operators, locomotive and hoisting and portable engineers. Periodic check examinations should be given men in jobs in which there may be health hazards, as for example, to sand blasters, radium and x-ray workers, and paint sprayers.

6.3. Special examinations such as x-ray, serologic and urinalyses should be given in the individual case as indicated and in accordance with local needs.

As these standards have been accepted by a national conference attended by representatives of management and labor in shipbuilding yards holding Maritime and Navy contracts and have been approved by the Navy and by the Maritime Commission, it is expected that, on a sound and practical basis, preplacement examinations on the Pacific Coast gradually will be extended as the necessary machinery and personnel become available.

OREGON STUDIES

Recently, Doctors Menne, Beeman, David, and Hunter of the Oregon Medical School investigated clinically some forty men and their working environment in the Oregon Shipbuilding Corporation † and published a report on their findings.[3] The yard employed, as of January 1, 1943, 32,843 workers. Of this number about 6,000 were welders, a normal proportion. As the Portland yard did not exist in 1940 and was about a year in building, most of the shipyard workers there, including welders, could not have had any extended shipyard experience. The report states (page 21) that the "length of service and, therefore, the possibility of exposure, usually varied from three weeks to eighteen months. Thirteen worked from one to six months, eleven from six months to one year, and the remainder from one year to a year and a half. A few were exposed for only a day or two."

The Menne report implies that further investigations are pending, but from the text of the published material, one must be satisfied with statements such as these (page 25):

It is fair to assume in the study of a group of individuals of this kind that there is sufficient evidence to warrant the conclusions that occupational fumes, gases, and dusts—are sufficiently hazardous, in certain locations, to *per se* cause disease processes in the lungs and the air passages. It also seems to us that regardless of a possible difference of opinion as to the seriousness of such clinical diseases, the conditions causing them can and should be corrected.

The evidence which Menne presents that things are amiss, or that novel industrial diseases are present in the shipyards, is far from clear.

ON AMOUNT OF EXPOSURE TO WELDING FUMES

In the Portland yard—and it applies equally to other shipyards using welding processes in a substantial manner—at least half the workers have, in legal parlance, some exposure to welding fumes. It is timely, therefore, to discuss briefly the effects, upon man, of breathing such fumes. One of the oldest industrial maladies we have is metal-fume fever, otherwise known as zinc shakes, brass chills, brass ague, and more recently as galvo. In the manufacture of brass, metallic zinc is added to molten copper. The boiling point of zinc happens to be about 100 degrees centigrade less than the melting point of copper. Consequently, a copious evolution of zinc vapor results immediately on adding zinc to the molten copper. The zinc vapor burns to the yellowish white oxide of zinc, ZnO, which rises as a cloud.

Galvanized iron is iron or steel coated with zinc. The zinc is applied in such a manner that a fairly strong union or alloying between the two metals results. In ship construction we use a certain amount of galvanized metal to prevent too rapid corrosion by sea water. When galvanized metal is welded, the heat of the torch or of the arc boils off some of the zinc, which rises as zinc oxide smoke exactly as in the manufacture of brass.

SYMPTOMS

If a workman breathes zinc oxide fume or smoke in sufficient amounts and for a sufficient length of time, he may have an attack of metal-fume fever.[4] After a half hour or so he may note a substernal pain on taking a deep breath, and while this does not become serious an attempt at deep breathing may elicit an unproductive cough. Violent coughing or vomiting is rare. A metallic taste gradually may develop. After about four to six hours the body temperature begins to rise, usually following a premonitory chill. This chill may develop into a real malarial-like shake—hence the name "zinc shakes." The fever may go as high as 103 degrees Fahrenheit or even more—I have recorded a 103.5 degrees Fahrenheit on myself—and gradually will subside, until twelve hours later the body temperature is usually normal.

The leukocyte count will begin to rise within an hour or two following exposure—well before the body temperature rises—and will remain above normal for some hours after the temperature has subsided. Differential counts show that the rise in white cells is due to increased polymorphonuclears. If a second zinc oxide inhalation is taken when the temperature has returned to normal but with the leukocytosis present, there is apt to be no reaction. Apparently, the leukocytosis offers some

† A Maritime contract yard at Portland, Oregon.

measure of protection. At any rate, attacks of metal-fume fever on two successive days are rare, and men usually say they get it most easily after a lay-off. We had no difficulty in confirming these general facts by breathing zinc oxide ourselves.[5]

Another point to be stressed is that the effects are not cumulative. Animals subjected to heavy concentrations eliminate the zinc oxide rapidly—it is all gone in a day or so. There is no storage in any part of the body, nor could we find in examinations of men who had been exposed daily to zinc oxide for as long as twenty years, that their health was affected in the slightest degree. Metal-fume fever apparently does not predispose to tuberculosis or any other respiratory disease.

STEEL-PLATE WELDING

In welding steel plates, iron is boiled off by the arc or by the gas torch and burns to ferric oxide, Fe_2O_3, which rises as smoke or fume of a rusty appearance. Deposits of the fume on white cloth look like a rouge, for that is exactly what it is chemically. If men or animals breathe rouge powder, no systemic effect results. There is no metal-fume fever. However, animals exposed repeatedly do not eliminate ferric oxide the way they eliminate zinc oxide. The deposits seem to remain. Perhaps the lesser solubility of Fe_2O_3 in body fluids accounts for the iron noted by Enzer and Sander [6] in their autopsy report on a welder who died in an accident.

If one strikes an arc, a minute amount of NO_2 gas, nitrogen peroxide, is formed. The process is nitrogen fixation, and is one of the steps by which nitrogen of the air is converted commercially into nitric acid and nitrates. This gas, NO_2, is toxic and will produce fatal lung edema if breathed in excessive dosage. It is a lung irritant and can, likewise, irritate the trachea and bronchii. In commercial welding, as in ship construction, there is little or no danger of gas poisoning, but there are times when ventilation of welding jobs undoubtedly is inadequate. With poor ventilation of closed jobs the atmosphere is unpleasant and may cause coughing. We know this should not be, and we admit that fume and smoke concentrations sufficient to reduce visibility occasionally occur, but the evidence from our yards all over the country is that these effects, such as cough, are transitory. Gradually we are improving ventilation and are supplying adequate masks or respirators, to be worn beneath the welding helmets when ventilation is impracticable.

ELECTRIC WELDING

Electric welding first used bare rods or bare electrodes. Now it is usual to have rods coated with various inorganic substances and some organic binders. The purpose of the coatings is to create a reducing atmosphere immediately around the molten pool so that the weld will not be unduly oxidized. There is no magic in these rod coatings. The manufacturers have patents covering them, but their chemical composition is known, and the gases and fumes which they give off are in no way mysterious.

LEAD POISONING

The priming coat of paint in our Maritime freighters contains, as pigment, red lead. It is common shipyard practice to paint out in the yard small parts and even some deck and hull plates before they are welded into place. This saves time. The risk of lead poisoning to the welders who must weld such painted metal into position is recognized. The heat of the welding arc boils off some of the lead and the welder breathes the lead fumes evolved. It is the rule to leave four inches or so along the edges unpainted and the painters go over this surface later. We have not yet assembled reliable figures on lead poisoning in our shipyards, but all evidence indicates that we have recognized the danger sufficiently soon to escape it by these simple preventive measures.

RE: STERILIZATION

It will surprise the medical profession to learn that we have had considerable unrest among both women and men welders because rumors had reached them to the effect that the welding arc gave off "x-rays which could cause sterility." It is our job to stop such gossip as it can easily assume serious proportions. We pointed out immediately that the medical profession was well aware of the sterilizing action of x-rays; that the machines which are used to cause sterility usually operated at 100,000 or 200,000 volts; that welding machines all operate at twenty to eighty volts and could not produce any x-rays at all.

EARLIER STUDIES

Doctor Menne and his colleagues evaluate as "piecemeal" (page 5) prior studies of the health risks in welding. In 1938, Enzer and Sanders [6] reported upon the lung changes in welders who had had abundant industrial experience. In 1940, Britton and Walsh [7] of Northwestern University Medical School reported upon the examination of 286 men who had welded more than five years.

In 1940, too, Harrold, McCord, and Meek [8] reported finally on extensive studies on animals and men exposed to welding fumes and gases. In 1942, Gardner [9] showed that animals with tubercular lesions are not further harmed by comparatively heavy exposures to welding fumes.

COMMENT

Careful appraisal and study of the work above mentioned leads to a definite conviction that it can in no sense be regarded as of the piecemeal variety, and we cannot conceive of its dismissal in such summary fashion by any reasonable and clear-thinking individual.

In 1927, Drinker, Thomson, and Finn [10] suggested figures of threshold concentrations of ZnO in workroom air so that ventilation requirements could be computed therefrom. In 1935,[11] these suggested standards of air purity were extended to include Fe_2O_3 from welding iron and steel as in shipbuilding, and the figures were modified further in 1941.[12] Doctor Menne's report quotes these figures and accepts them.

There has been no attempt on the part of any of these investigators cited to belittle the health risks of welding. In fact, all of us have been accused by those interested in the practical aspects of welding as having stirred up unwarranted apprehension.

No useful purpose will be served by detailing the technical errors, especially in engineering, in the report of Doctor Menne's committee. We do not question the authors' good faith or good intentions. We agree with most of their eleven final recommendations, for many had been adopted last December in our Health and Safety Standards. We disagree with others. We would welcome improvements in goggles, helmets, air masks, or anything of the sort, but we cannot and will not recommend the general use in our yards of any protective equipment which has not been tested and approved by a reliable agency, such as the Bureau of Mines or Bureau of Standards.

STAFF OF THE MARITIME COMMISSION AND THE NAVY

The Maritime Commission and the Navy set up last December [13] a permanent staff of Safety and Health consultants for all of the contract yards in the country. Our physicians, industrial hygienists, and engineers know thoroughly what conditions are like in double bottoms, deep tanks, and refrigerator rooms. We go wherever the men go or are expected to go. We examine and take samples of the air in the course of our inspections. We attempt to anticipate and to prevent accidents of all kinds. We check constantly on the ventilation equipment, goggles, safety shoes, and guards of all sorts around machinery in every yard. We check in detail on the medical and first-aid facilities and general procedures in all yards. Our men are available at all times for consultations with management or with labor.

IN CONCLUSION

We note Doctor Menne's complaint that education of the men in the risks of welding and in the proper use of their protective equipment is not always good. We quite agree, and if his committee can help us improve the teaching in our apprentice schools and training courses we would welcome their aid.

The climax of the report and its chief objective is contained in the final recommendations for the adoption of an occupational disease law in Oregon. Since the recommendation was made, such action has been taken by the State. As representatives of the Federal Government we must accept State rules and State laws as we find them, and since this is exclusively a State matter, we have carefully avoided any comment on that section of the report.

c/o U. S. Maritime Commission, Washington, D. C.

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MEDICAL SERVICE IN THE U.S.S.R. ARMY

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THE most recent offensive undertaken by the Soviets has found medical science advanced to the point where it is able to cope with the needs of front and rear alike. Russia has been able to hold her losses of the wounded to less than 1½ per cent. This remarkable fact helps to explain the phenomenal strength and stability of her forces, for into her front lines returns a constant stream of seasoned veterans already baptized in the fire of bloody war and now recovered sufficiently to be a vital force in the conflict.

We can gain some understanding of the scope of the odds which have been surmounted when we realize that all the valuable equipment of institutions in cities which fell into enemy hands had to be previously removed. My own Alma Mater, Kharkov Medical Institute, I am thankful to say, is now operating in safety in the remote rear in the city of Chkalov.